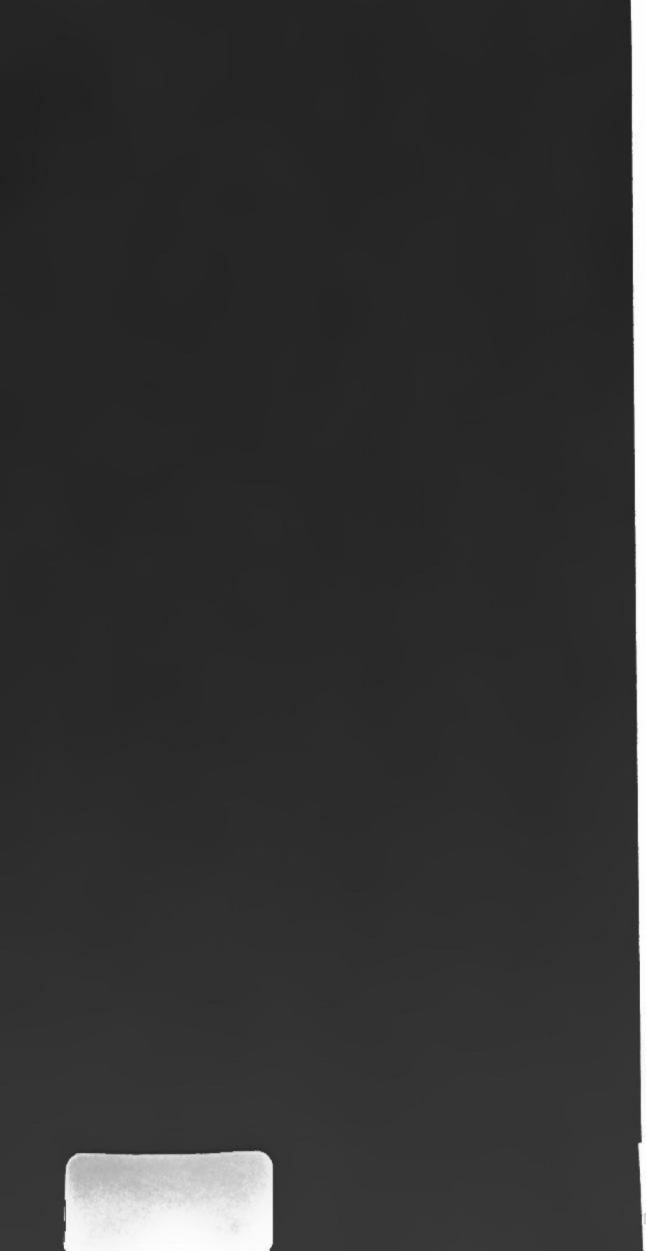
Collected papers

Edward Charles Jeffrey



COLLECTED PAPERS

of

Edward Charles Jeffrey

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Contents

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No. 9.—A NEW ARAUCARIAN GENUS FROM THE TRIASSIC.

BY EDWARD C. JEFFREY.

In the early part of the year 1908, my friend Professor J. B. Woodworth of the Geological Department of Harvard University, turned over to me for investigation a remarkable trunk, from the Triassic forest, south of Adamana, Arizona. The specimen to be described was collected by Mr. John B. Lewis, Jr., of Reading, Massachusetts, and by him presented to the Geological Museum of Harvard University, whence it came into my hands through the kindness of Professor Woodworth. In December, 1899, Dr. Lester F. Ward, at that time paleontologist to the United States Geological Survey, made a report on the fossil forests of Arizona ("Report on the Petrified Forests of Arizona," Washington, 1900). More recently Dr. Ward returned to the same subject in one of the Monographs of the United States Geological Survey (Monogr. U. S. Geol. Surv., no. 48, 1905). Since the present investigation was completed, a large amount of material, some of it collected by Dr. Ward himself, from this region has come into my possession for examination, through the courtesy of Dr. David White and Dr. F. H. Knowlton of the United States Geological Survey, as well as through the kindness of my colleagues Professors Wolff and Woodworth. It represents a considerable variety of forms and promises to yield results of great interest to evolutionary botanists, which will be published subsequently.

Fig. 1 (Pl. 31) represents a photograph of about two thirds of the length of the petrified stem in my possession, reduced to one half its natural magnitude. The missing third of the specimen was used for the purpose of securing sections, showing microscopic structure, which were prepared with his usual skill, by Mr. James Lomax of the Lomax Paleobotanical Company, Bolton, England. On the right of Fig. 1, the specimen presents some adherence of the matrix in which the tree was included. Towards the left the surface of the trunk has become clear of the surrounding rock as a result of the weathering process to which it has been exposed. Externally the wood is a pale yellow or orange color, while inwardly the natural dark brown hue of the silici-

fied wood is retained. Over the surface of the trunk are a number of scars. The smaller of these would naturally be interpreted as either the cicatrices of possibly Araucarian leaves or perhaps as the rootlet scars of a Stigmarian root, if it were conceded that this genus were present so late as the Arizona Triassic. Investigation showed that neither of the more obvious interpretations of the smaller superficial scars could be adopted. Two larger scars appear, one in the middle line and another to the right of it. In the light of subsequent description of the internal structure, it is clear that these are the broken bases of branches of the main axis. In Fig. 2 (Pl. 31) is shown the opposite side of the same slightly flattened trunk. Part of the surface is obscured by the label of the Geological Museum, but enough is left clear to show that this surface presents a close similarity to that shown in Fig. 1. A little to the left of the middle line below, is seen a third larger scar, representing the broken base of a ramification. With some clearness on the right and left above may be seen, in longitudinal aspect, the organs which are responsible for the rounded scars in the middle line. The appearance thus presented indicates that a considerable amount of the surface of the trunk has been removed either previous to fossilization or more recently as a consequence of the weathering of the petrified trunk. By regarding the smaller scars shown in Figs. 1 and 2 with a pocket lens, it may be made out that they are multiple in their nature in some instances and represent a large main scar accompanied by one or more smaller scars. This can be made out with special clearness in the upper median region of Fig. 2. Fig. 3 represents the natural weathered end of the trunk shown in the two foregoing figures. The process of weathering has etched out admirably the annual rings, so that they appear much more distinctly than they do even in microscopic sections of the better preserved parts of the trunk. By examination of the rings with a lens it may be readily determined that the trunk was approximately half a century in age, when the tree was fossilized, if all the annual increments of growth are represented, which seems probable. It is possible to make out that some of the original layers of the wood are missing on the flattened surfaces of the trunk. Radiating lines can be distinguished on the end of the log, which represent the organs seen as the smaller scars in Figs. 1 and 2. A little to the right of the geometrical center of Fig. 3 (Pl. 31) and a little above it, appears the medullary region of the trunk.

With the foregoing description of the external features of our fossil we may now pass to the consideration of its internal structure. The preservation of the tissues left much to be desired, but by the examination of a considerable number of sections, data were reached, which make it evident that in the present specimen we have to do with a new and very interesting Araucarian genus. Fig. 4 (Pl. 32), shows the wood of the trunk under moderate magnification. In no case was it found profitable to employ very high magnifications of the histological structure, on account of the somewhat unsatisfactory condition of preservation. Fig. 4 illustrates the transition from one annual ring to the next. It is to be observed that the autumnal pause in wood formation is very slightly marked, much less so than we have observed to be the case in Cretaceous material from the eastern United States. The rays do not stand out clearly in the transverse section, since they are indifferently preserved. Certain dark spots occur throughout the field of the photograph, which do not, as might be supposed, represent resiniferous parenchyma, but merely carbonized aggregations, such as are not infrequent in petrified woods. Fig. 5 (Pl. 32), shows the radial section of our wood, which indicates very clearly the indifferent condition of preservation. The pitting, however, is clearly that of Araucarioxylon and as in that type the pitted regions are not coincident with the whole surface of the tracheids but are distinctly localized towards their ends, as in the woods of the living Araucarian genera, Agathis and Araucaria. The same carbonized blotches as are apparent in the transverse section can also be made out in the radial view. The rays have not been shown, as their condition of preservation as seen in this plane is indifferent. By looking over a considerable number of preparations, however, it was possible to discern that the ray cells had numerous pits on their lateral walls and apparently were entirely devoid of pits on their terminal and horizontal wall, precisely as is the case in the rays of the living Araucarian genera. Fig. 6 (Pl. 32), shows the tangential view of a less badly preserved portion of the wood. It can be made out that the rays are strictly uniseriate and from two to eight or nine rows of cells in height. Evidence of tangential pitting of the autumnal tracheids was rather dubiously discerned. The condition of preservation left always some uncertainty on this point. It will be seen from the description of the wood of our specimen given in the above lines, that it represents a quite typical Araucarioxylon. The frequently rounded pits of the Brachyoxylon

type were not made out, although this type of wood was found in other petrified fragments from the same general horizon. Fig. 7 (Pl. 32) is of particular interest because it shows in the upper part, in transverse section, one of the organs responsible for the scarred surface of the trunk. It is quite obvious that we have to do in this case with an appendage not of the nature of a leaf, on account of the cylindrical character of its trace. By looking carefully, by preference with a lens, at the lower part of the figure, it is possible to make out clearly that the organ just referred to is subtended by a leaf-trace. The organ in question is consequently clearly an axillary structure and either a root or a branch. An examination of its transverse section with the microscope makes it clear that it is not a root. Hence we must interpret it as of shoot value. It is in fact a short-shoot, as is shown by its failure to develop annual rings in the outer part of the trunk. Fig. 8 (Pl. 32) shows one of these short-shoots in transverse section at a point considerably farther out. The cylindrical character of the woody axis of the organ can be clearly made out as well as the absence of annual increments of growth. Fig. 9 (Pl. 32) shows the appearance of the organs in question, very near to the surface of the trunk, under the same magnification as Fig. 8. It will be seen, that the pith and as a consequence the woody cylinder of the short-shoot have both become considerably larger.

Not infrequently the short-shoots of this remarkable Gymnosperm branch in the course of their journey outward and sometimes at the surface of the trunk they are represented by as many as four or even five branches. This is all the more remarkable because there are no leaf-traces emitted from the cylinder of the short-shoot in their passage through the wood of the main axis, as is the case in *Ginkgo biloba*, in which I have observed a similar branching of the short-shoots within the wood of the parent axis. Ginkgo also differs from our genus in the fact that its short-shoots generally show the presence of annual rings, which are always absent in the type under discussion. The short-shoots apparently were lengthened in accordance with the thickening of the woody cylinder of the main trunk, through the activity of the cambium of the mother axis, exactly as is the case with the short-shoots of the living genus Pinus, in which the short-shoots persist in some species for a half a score or more years.

The leaf-trace in our genus is also of considerable interest, because unlike the short-shoot, which it subtends, it has a limited duration and

disappears in the wood of the main axis at a comparatively short distance from the pith. In living Araucarian Conifers, as well as in allied fossil forms, a remarkable feature of structure is the persistence of the leaf-trace in the wood throughout the life of the axis. This feature has been referred to by Sir William Thiselton-Dyer ("Persistence of Leaf-Traces in Araucarieae," Ann. Bot., vol. 15, p. 547, 1901). Professor Seward has also called attention to it in his recent monograph on the Araucarieae ("The Araucarieae, Recent and Extinct," Phil. Trans. Roy. Soc. London, ser. B, vol. 198, p. 305–411, pls. 23, 24, 1906) and considers it a primitive feature which the Araucarian Conifers have retained from the past. Professor Lignier likewise refers to the persistent Araucarian leaf-trace in the case of Mesozoic representatives of the group, in a recently published memoir. It appears very doubtful if Professor Seward's view of the primitive nature of the persistent leaf-trace of the Araucarineae can be maintained, as it is not found in the case of the very ancient Araucarian genus at present under discussion. It is my intention to show in a subsequent article that the general condition of the leaf-trace in the older Araucarineae of the Mesozoic does not at all support the view put forward by Professor Seward, that the persistence of this structure in the secondary wood of certain modern representatives of the tribe is an inherited primitive feature. The opposite conclusion seems to be warranted by the facts, *viz.*, that the persistence of the trace of the leaf in the secondary growth of the living genera is not a palingenetic feature, but one which has been more recently acquired.

It is apparent from the description given above, that in the genus which is the subject of the present article, we have to do with a representative of the Coniferous stock, characterized by the wood structure of the modern Araucarineae, without the persistent leaf-trace which is characteristic of these, and with short-shoots, such as are found today clearly marked in the genus Pinus only. Since there is no indication of any but Araucarian characters in the wood we are justified in including our genus with the general Araucarian stock. That it is an entirely new type of that stock is likewise apparent. For that reason it must be put in a new genus, which we propose to call in honor

of Professor J. B. Woodworth, to whom we are indebted for the material

Woodworthia arizonica, genus et species nov.

Wood of the Araucarioxylon type, with alternating radial pitting of the tracheids, generally grouped at the ends of the elements; short-shoots present, which persist through many years, probably as long as the axis, which bears them; leaf-traces subtending short-shoots and not persistent throughout the secondary wood as in existing representatives of the Araucarineae; annual rings not strongly marked.

Triassic forest near Adamana, Arizona.

Conclusions.

It will be apparent to the reader that in the case of the new genus, which is the subject of the present article, we have to do with a remarkable Araucarian type. Although it is not the first extinct Araucarian conifer known to possess short-shoots, since another type has been described from the Lower Cretaceous of Staten Island, N. Y., ("Araucariopitys, A New Genus of Araucarians," Bot. Gaz., vol. 44, p. 435–444, pl. 28–30, 1907) it is nevertheless the first to show the typical Araucarioxylon structure associated with the presence of short-shoots. Moreover, the large size of the trunk investigated in the present instance, leaves no doubt as to the persistence of the base of the short-shoot in the successive annual rings of the mother axis. It is clear from a consideration of the present very important genus, that the Araucarian line in its older representatives approximated more and more to the Abietineous type illustrated by Pinus and Prepinus. Both Araucariopitys and Woodworthia vouch for the soundness of this general conclusion. The evidence for the primitive presence of short-shoots in the Araucarian line (Woodworthia and Araucariopitys) as well as in the Abietineous series (Pinus and Prepinus) seems now to rest on a very firm basis. Moreover, this condition in the vegetative axes of the earlier Conifers affords a most satisfactory support to the conclusions reached by the greater number of morphologists as to the interpretation of the female cone of the Conifers in general. As is well known the present tendency is to regard the

ovuliferous scale of the Conifers as the equivalent of a metamorphosed short-shoot. In the light of recent investigations on the fossil Conifers this hypothetical explanation of the morphology of the seed-bearing appendages of the female cone receives a very satisfactory corroboration. Further, nothing could be more in harmony with present tendencies in morphology, than to find that the short-shoot or its equivalent has persisted at least in a vestigial form, in connection with the reproductive apparatus long after it has disappeared or almost disappeared in the vegetative axis of the living Conifers, with the exception of the very ancient genus Pinus. We may then safely assume that the presence of short-shoots was a primitive attribute of the Coniferous stock and that as a consequence we find it present in older representatives of those two Coniferous tribes, *viz.*, the Abietineae and the Araucarineae, which we know to have had the longest geological history.

Another feature of interest connected with the genus described in the present article, is that it adds one more bond to the evidence connecting the Abietineae and Araucarineae. As a result of recent investigations on the woods of the American Lower Cretaceous, we know that the ligneous structure of some of the older Araucarian Conifers more nearly approached the Abietineae than is the case with any of those now living. The proof afforded by the genus Woodworthia of the presence of short-shoots in the Araucarian line at so remote a period as the Trias, supplies an additional and very weighty piece of evidence as to the Abietineous origin of the Araucarian Conifers. As far back as the Triassic we find the tendency of the Araucarineae to become more and more like the Abietineae, clearly indicated. Whether this evidence is confirmed by the consideration of the general wood structure of the more ancient Araucarian Conifers, will be discussed in an extensive memoir, now in preparation.

Summary.

1. Woodworthia, an ancient Araucarian genus from the Triassic forests of Arizona, possessed the wood structure of the living representatives of the Araucarineae.

2. It at the same time was provided with short-shoots of the Abietineous type, which persisted in the wood of the trunk throughout the life of the tree.

3. The leaf-traces of Woodworthia, unlike those of the living Araucarineae, did not persist in the secondary wood.

4. Persistent leaf-traces cannot be regarded as an ancestral character of the Coniferous stock.

5. Woodworthia supplies additional evidence of the approximation of the Abietineous and Araucarineous lines in the Mesozoic.

6. The Abietineae represent the most primitive living Conifers.

7. The possession of short-shoots was probably a common feature of the older Coniferous stock and such an hypothesis supplies satisfactory evidence for the most generally accepted explanation of the ovuliferous scale in the existing Conifers, as a modified short-shoot or brachyblast.

Printed July, 1910.

EXPLANATION OF PLATES.

PLATE 31.

Fig. 1. Surface of trunk of *Woodworthia arizonica*. × ½.
Fig. 2. Surface of the opposite side of the same trunk. × ½.
Fig. 3. End view of the same trunk reduced to one half the natural size.

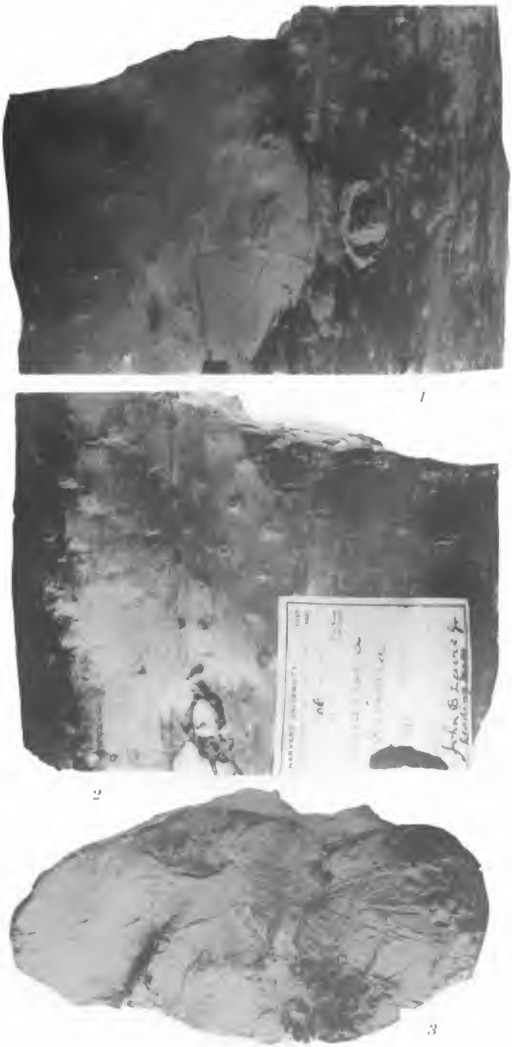
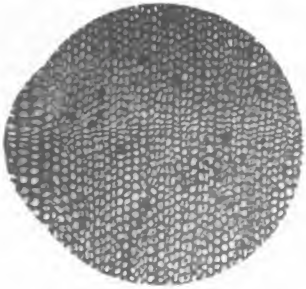


PLATE 32.

Fig. 4. Wood of *Woodworthia arizonica* in transverse section. × 40.
Fig. 5. Longitudinal radial section of the same. × 120.
Fig. 6. Longitudinal tangential section of the same. × 120.
Fig. 7. Tangential section of the wood of the same showing a short-shoot and its subtending leaf-trace. × 10.
Fig. 8. Transverse section of short-shoot of the same about four centimeters from the pith. × 40.
Fig. 9. Transverse section of a short-shoot near the surface of the trunk. × 40.



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